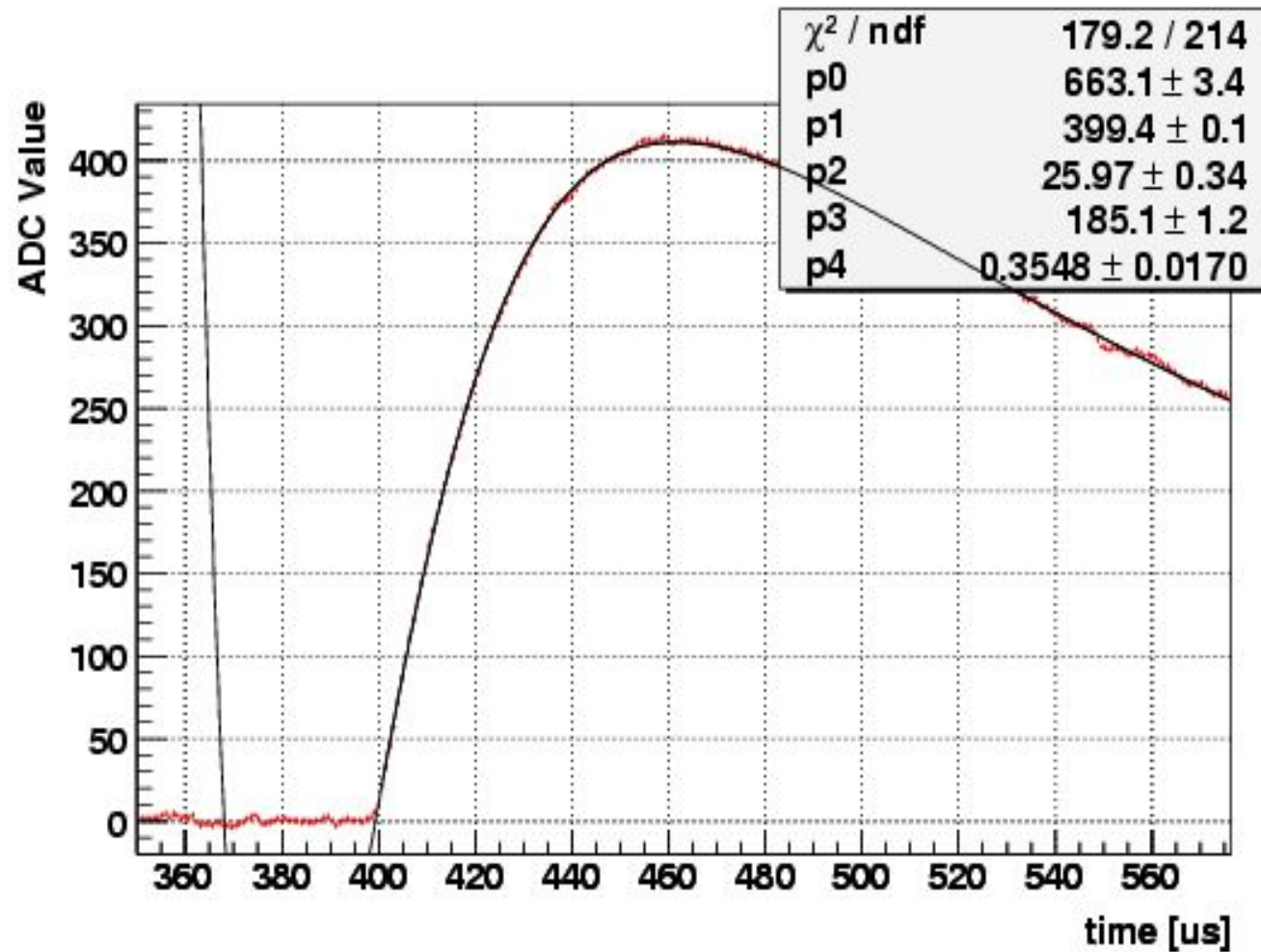


Implementation Of PipeFit



Trace Preprocessing

- Calculate typical trace characteristics
 - **PED**: average of 1st 400 ADC values
 - **RMS**: std. dev. of 1st 400 ADC values in trace
 - **MAX_ADC** and **MAX_ADC_BIN**:
 - Charge: max ADC value between bins 450 and 550
 - Phonon: max ADC value between bins 500 and 700
 - (NOTE: trigger bin is at 512)

Leading Edge Fit Function

- Leading edge fit function $r(t)$ has 2 time constants (τ and κ)

$$r(t) = A \left[1 - e^{-\left(\frac{t-T_0}{\tau}\right)} \right] \times \left[e^{-\left(\frac{t-T_0}{\kappa}\right)} - G e^{-\left(\frac{t-T_0}{\tau}\right)} \right]$$

$$P_0 = A$$

$$P_1 = T_0$$

$$P_2 = \tau$$

$$P_3 = \kappa$$

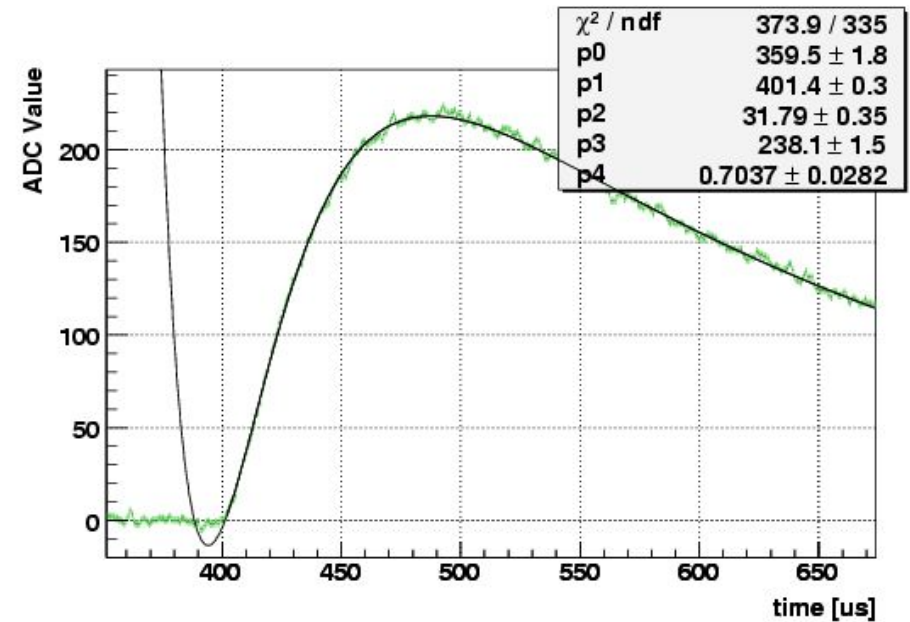
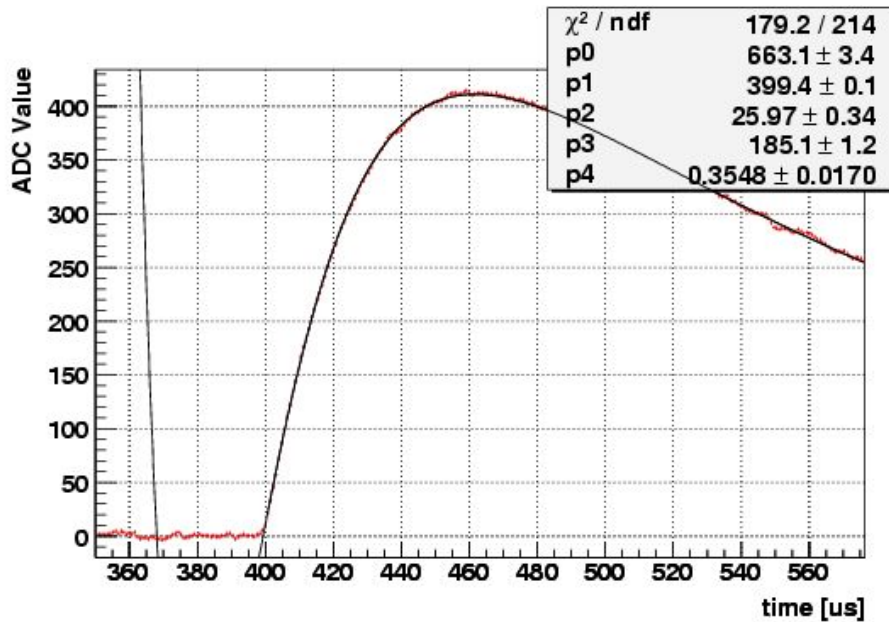
$$P_4 = G$$

Leading Edge Fit

- Determine fitting range
 - Start = bin at which trace crosses $2 \times \text{RMS}$ provided ($\text{MAX_ADC} < 200$), else = bin at $0.05 \times \text{MAX_ADC}$
 - Set $dx = (\text{MAX_ADC_BIN} - \text{Start})$
 - Fitting range = $[3 \times dx + 50]$ if $(x < 30)$; else $[x + 100]$
- Initialize fit parameters
 - $P0 = 2 \times \text{MAX_ADC}$; $P1 = \text{MAX_ADC_BIN} - 4$
 - $P2 = 0.5 \times x$; $P3 = 2.5 \times x$
 - $P4 = 0.8$
- Implement MINUIT (MIGRAD) minimization

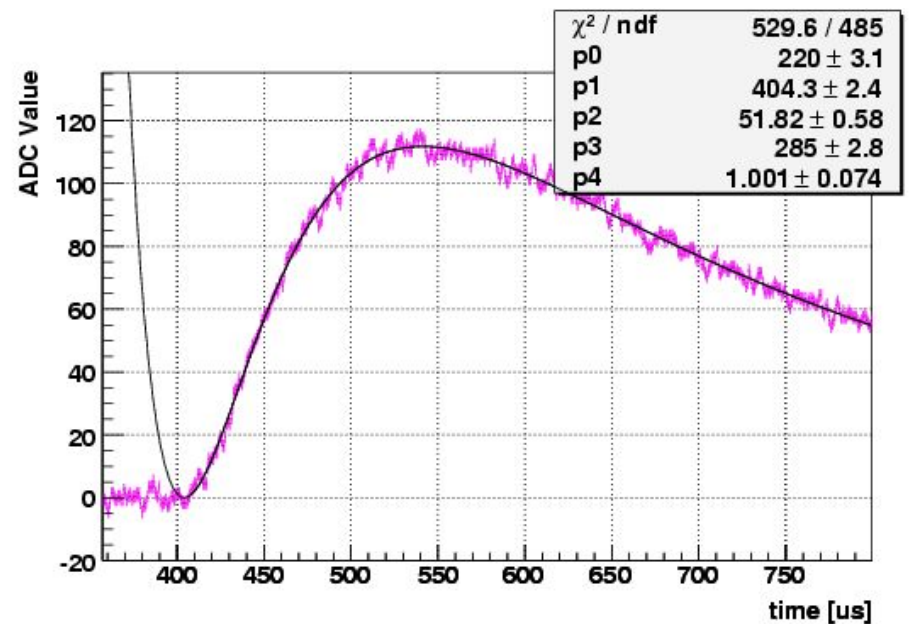
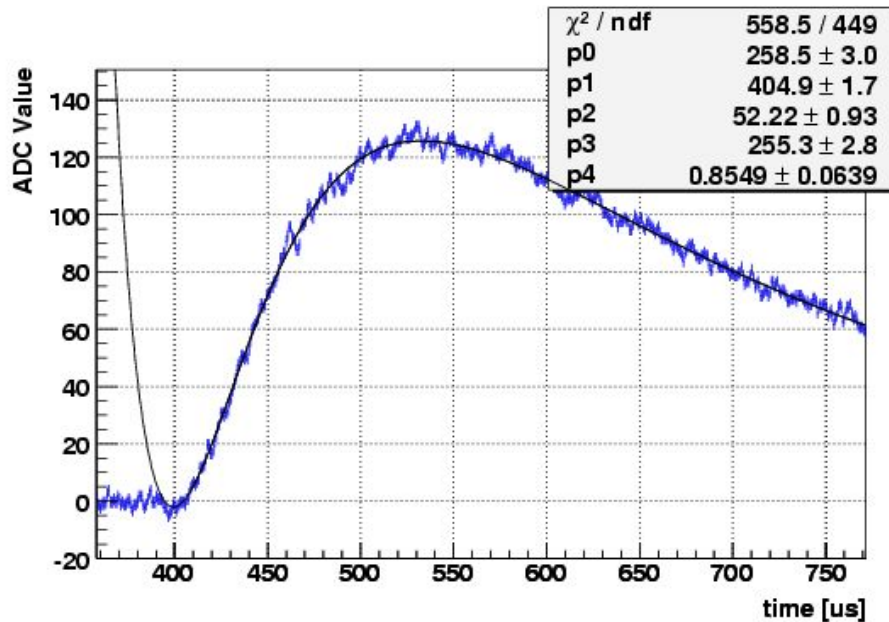
Leading Edge Fit Example

- 140510_0946 (Cf), evt 20023, T2-Z5 (pA + pD)



Leading Edge Fit Example

- 140510_0946 (Cf), evt 20023, T1-Z5 (pB + pC)



Comments About Leading Edge Fit

- P1 & P4 have special correlation
 - $P4 < 1 \Leftrightarrow r(t)$ has 2 zeros: P1 is 2nd zero, and P1 is true start time of the pulse
 - $P4 = 1 \Leftrightarrow r(t)$ has 1 zero: P1 is true To
 - $P4 > 1 \Leftrightarrow r(t)$ has 2 zeros: P1 is 1st zero, and 2nd zero is true start time of the pulse
- The $r(t)$ global minimum decreases with increasing MAX_ADC; put another way, the separation of the 2 $r(t)$ zeros increases with MAX_ADC

Trailing Edge Fit Function

- Trailing edge fit function $f(t)$ also has 2 time constants (κ_2 and κ_3)

$$f(t) = A \left[e^{-\left(\frac{t}{\kappa_2}\right)} + H e^{-\left(\frac{t}{\kappa_3}\right)} \right]$$

$$P_0 = A$$

$$P_1 = \kappa_2$$

$$P_2 = \kappa_3$$

$$P_4 = H$$

Trailing Edge Fit

- Determine fitting range
 - Start = end point of fit for leading edge function $r(t)$
 - End = bin 2040
- Initialize fit parameters
 - $P0 = 40 * MAX_ADC$
 - $P1 = 150; P2 = 500$
 - $P2 = 0.007$
- Implement MINUIT (MIGRAD) minimization
 - Use every 4th bin between Start and End only for speed